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PRECIS OF LECTURES

ON

MILITARY CARRIAGES, ETC.,

FOR THE USE OF THE

GENTLEMEN CADETS OF 1st CLASS,

ROYAL MILITARY ACADEMY.

BY

BT.-LIEUT.-COLONEL W. KEMMIS, R.A.

WOOLWICH:
PRINTED AND PUBLISHED BY F. J. CATTERMOLE, ARTILLERY PLACE.
1882.

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PRECIS OF LECTURES

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MILITARY CARRIAGES, ETC.

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Resistance to rolling is caused by obstruction of the ground to the onward motion of a wheel: this may be due to—

1. Raised obstacles, as stones in the path of the wheel.
2. The wheel sinking into a rut, or trench, and consequently having to rise out of it again.
3. Inclination of the ground.

The amount of resistance opposed either by a raised, or sunken, obstacle cannot be measured by the height to which the wheel has to be lifted to pass over the former, or get out of the latter, as the mere height gives no indication of the power of the wheel, due to its diameter, for surmounting the obstruction.

The resistance is therefore measured, not by the height the wheel has to be raised, but by substituting for it an equivalent incline, the angle of which depending both upon the height of the obstruction, and upon the radius of the wheel, gives a true measure of the resistance opposed to the motion: further such an angle is convenient for purposes of calculation.

The incline (FGB′), equivalent to an obstruction of given height (FB′), is arrived at, if the wheel is on level ground as in FIG. I, and if on sloping ground as in FIG. II, by drawing a tangent (B′G) to the wheel at its point of contact with the obstacle, when about to surmount it, to meet the original ground line (FB).

FIG. I.—*Wheel on level.*

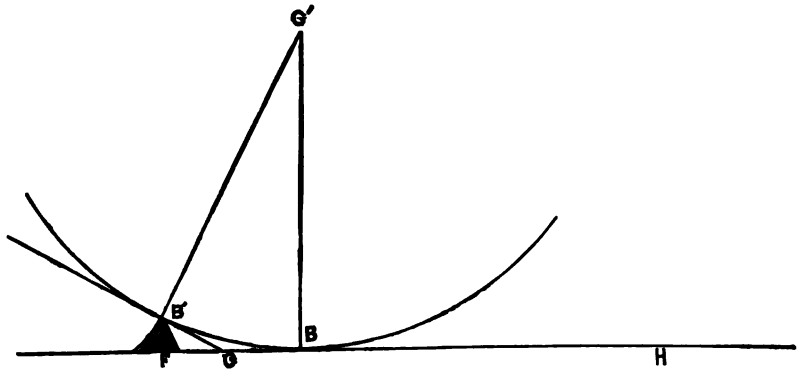
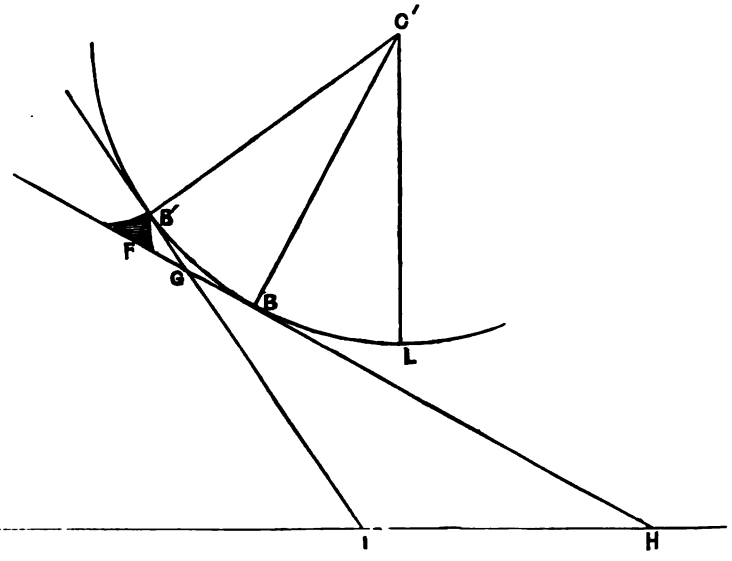


FIG. II.—*Wheel on slope.*



If a radius (B′C′) be drawn from the point of contact to the centre of the wheel, and another (BC′) perpendicular to the ground line, it will readily be seen that the angle included between them is equal to the incline due to the obstacle, and is more convenient for measurement than the latter.

In FIG. II, if the vertical C′L be drawn, it will be seen that the angle BC′L=BHK, the original slope of the ground, and that the angle B′IK, the total inclination due to the ground and obstacle together, equals the angle B′C′B+BC′L=B′C′L.

To move a weight up an incline less force is required if applied in a direction parallel to the incline, than if applied in a direction parallel to the horizontal.

Obviously the direction of the tractive force to a carriage, that is, the inclination of the traces cannot be varied to suit the different obstacles, &c., which the wheels may meet.

An average obstruction is therefore selected, and the inclination of the traces made to correspond to that slope which it opposes to the wheel's motion.

The obstruction selected is that corresponding to a slope of 6½ degrees, and consequently this is the inclination which is therefore given to the traces.

The line of draught should if possible be taken direct from the fore axle, for if taken from a point above it, as is frequently the case, a strain is produced upon the fore carriage if the shafts are hinged to it, or a pressure upon the horse's back if they are fixed, proportional in each case to the amount of tractive force exerted in moving the carriage.

The tractive power of a horse depends on the duration of his labour

and upon the speed at which he travels: it may generally be taken for duration of labour from 4 to 5 hours, as follows:—

Trotting at speed of about 7 miles an hour, 70lbs.
" " " 6 " 82lbs.

The relation, mathematically deduced, between the tractive power P and weight behind it, on level ground, is given by the equation $P=\frac{r.\,W''.\,cos\,\epsilon.\,\mu}{R}+(W''+W')\,sin\,\epsilon$. Where r = radius axle, R= radius wheel, W'' = weight of carriage and load, W' = weight of wheels, ϵ = inclination of traces, μ = co-efficient of friction between wheel and axle. If the carriage is upon ground sloping at an angle with the horizontal = γ, for $sin\,\epsilon$ must be substituted $sin\,(\epsilon+\gamma)$.

From calculation and experience we find that, corresponding to the above duration of labour and respective rates of motion, the horse may be expected to draw under service conditions:—

In Horse Artillery, about 5¾ cwts.
In Field Artillery " 7 cwts.
In Transport (without springs), &c., 9¼ cwts.

Teams of two abreast only are adapted to field service.

Six horses are the greatest number which can usefully be employed in the field for manœuvre; eight may be employed exceptionally, but with loss of useful effect.

The weights which the different teams should draw, under ordinary service conditions, are about as follows:—

Horse Artillery ...	team of	six	34¼ cwts.
Field "	"	six	42 "
Field "	"	eight	49 "
Field Transport	"	four (wagon without springs)	38 "
"	"	six "	57 "
"	"	four (wagon with springs)	54 "

The weight behind a team includes the carriage and its load, and in order that the weight of the latter may be as great as possible, the weight of the former must be a minimum consistent with the requisite strength.

To make the draught as easy as possible, the load must be distributed in the proper proportion over the fore and hind axles; in the field gun carriage the distribution desired must be modified to meet particular circumstances, thus: there must be carried the gun, the necessary ammunition and stores, entrenching tools for immediate use, and also sufficient men to serve the piece. The quantity of ammunition, stores, and tools, should be enough to render the gun sufficiently independent of its wagon in action: it is usually laid down that the number of rounds with the gun should be from 30 to 40, and of this about four rounds should be at hand in action on the gun carriage: the total number of rounds carried by a battery, that is between the gun carriages and the wagons, should be from 100 to 150 per gun, or sufficient to render the battery tolerably independent of the first reserve of ammunition in an action.

The mode of draught of a carriage may either be "shaft" or "pole;" in the British service the former mode is preferred for field artillery carriages, because there is more control over the carriage for manœuvre, while it is better for crossing bad ground. Pole draught is however the simpler arrangement, and divides the strain more equally between the wheel horses.

NOTE ON 13PR. R.M.L. FIELD CARRIAGES.

The following are the chief points of difference between the carriages of the 13-pr. equipment and that of the 9 or 16-pr.

THE GUN CARRIAGE.—This is constructed of steel, instead of wrought iron, for greater strength.

The wheels have an additional grease chamber, which not only gives greater space for grease, but supplies it at the outer bearing on the axle (the grease having a tendency to run up the arm), while it is arranged to admit of being filled without removal of the wheel from the arm.

The axletree and bed is of the "bow-string" girder form, which is of greater strength than the "box" girder in being of greater depth under the brackets and throwing the strain on discharge in the direction of the length of, rather than across, the axle. The latter is not weakened by many rivet holes, and is readily removable.

The brackets have the plate inside the angle of the frame, which causes greater mutual support between the two, and takes the strain off the rivets.

The trail is short, making an angle of about 30° instead of 23° with the ground, which tends to lighten and at the same time strengthen the trail; it has, however, a tendency (though practically imperceptible) to increase the "jump" by decreasing the resistance to the latter offered by the moment of the weight of the gun and carriage about the point of the trail. Further, it tends to check recoil by increasing the tendency of the trail to dig into the ground.

The tensile stays are comparatively long, to bring the strain thrown upon them, and from them to the brackets, more in the direction of their length; they are readily removable for repair.

The elevating gear is the worm wheel pattern with friction cone.

There are no axle boxes, but simple axle seats on springs; on each bracket are bands for leather cases, in which a round of ammunition can be placed, if desired, from the limber.

THE LIMBER—Has the bow string girder axle and bed; the axle interchangeable with that of the gun carriage.

It has four futchells instead of three, and carries but two boxes (the fuzes and tubes packed with the remainder of the ammunition), these open to the rear, enabling the ammunition to be readily removed. The boxes contain each 18 rounds.

THE WAGON BODY—Has also the bow-string girder axle and bed, the axle interchangeable with that of the limber and gun carriage.

The hind boxes open to the rear, but the front at top; their packing is neither identical with each other nor with that of the limber boxes.

They carry 70 rounds, making, with those of the limbers, 142 rounds per subdivision.

NOTE ON THE MONCRIEF HYDRO-PNEUMATIC DISAPPEARING SIEGE GUN CARRIAGE.

THE carriage consists of a body upon a siege axle with siege wheels, the latter 5′ 6″ in height, an hydraulic cylinder with plunger, two radius bars and elevating gear.

The body of the carriage is in the form of an obtuse-angled triangle, the obtuse angle downwards, the front acute angle attached to the axle and the rear acute angle, forming the point of the trail, resting on the ground.

The cylinder, of metal, is supported on trunnions at the obtuse angle of the body of the carriage: its interior is formed in two compartments connected towards the lower part by two valves: the plunger, or ram, carrying the gun, by its trunnions, in a fork at its upper extremity, works in the central or inner compartment: the trunnions of the gun are also secured in the radius bars which pivot round the axle of the carriage.

The breech of the gun is connected by bars with elevating worm wheel gear on the carriage, and is so arranged that the gun in the loading position is brought horizontal without respect to the elevation it had in the firing position.

For action the carriage is secured to a holdfast in front, plates are placed under the wheels and trail, and the cylinder filled about ¾ with water and ¼ with compressed air (by means of an air pump, or from an air-holder of metal previously filled by means of an air pump). The exact proportion of air to water and amount of compression of the former has to be properly adjusted.

On discharge, the gun, being in the firing position, forces the ram into the cylinder, the water under the ram being driven to the outer compartment of the cylinder through one of the valves (the "discharge" valve—by which it cannot return) and compressing the air there still further. During this recoil of the gun its trunnions pivot in the radial arms and in the head of the ram, the radial arms round the axle and the cylinder on its trunnions.

To bring the gun from the position of recoil (or loading) to the firing position, the other valve (or "raising" valve, which permits of the water returning from the outer to the inner compartment of the cylinder), is opened by a lever, when the force stored up in the compressed air comes into play, forcing the water back under the ram and raising the latter with the gun. The rise of the gun, by means of the lever handle, is under perfect control, but to prevent it going further than desired, there are check chains.

The chief advantages of the system are as follows:—

The gun is effectually covered except at the moment of firing, and fires over 7′ 6″ parapet, instead of 5′ 6″, as in the ordinary overbank carriage.

It is brought from the loading to the firing position without labour.

The recoil is taken up mainly in the carriage, no labour being necessary to run up, and the detachment remaining close to the parapet.

The strain of discharge is usefully absorbed, instead of hurtfully expended on the carriage.

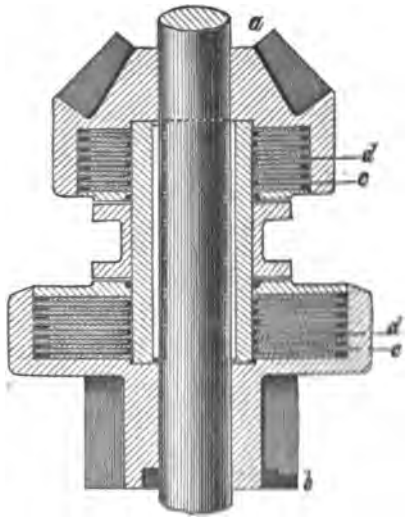
No ground platform proper is required.

The chief disadvantages of the system are, that with small charges sufficient compression of air cannot be obtained to bring the gun back to the firing position, also that a holdfast is required for the carriage: it is however to be noted that a holdfast is equally required with such siege carriages as it has been found necessary to fit with the hydraulic buffer in order to control the recoil.

NOTE ON THE 12·5 INCH R.M.L. CARRIAGE AND PLATFORM. MARK II.

THESE differ from Mark I. in having the hydraulic buffer attached to the bottom of the carriage, instead of to the platform, and recoiling with it and the piston-rod secured to the front transom of the platform instead of to the carriage: by this arrangement on discharge the rod is placed in tension instead of under compression, which description of strain it can better withstand. The front buffer-cap of gun-metal forms the bracket for securing the front of the buffer to the carriage, the rear being attached by means of a wrought-iron band.

The platform is fitted with a disc, instead of a cone-clutch, in the traversing and running-back gear: this consists of two parts, one for traversing (*a*), and the other (*b*) for running back. Each is formed of a series of plates alternately of gun-metal (*c*) and of steel (*d*), the former revolving with the pinion, and the latter with the shaft; when these are pressed together, by the clutch lever, against either of the pinions *a* or *b*, and the shaft is driven by the winch handle; the clutch and pinion revolve with the shaft.



F. J. CATTERMOLE, PRINTER, WOOLWICH.

Plate I.

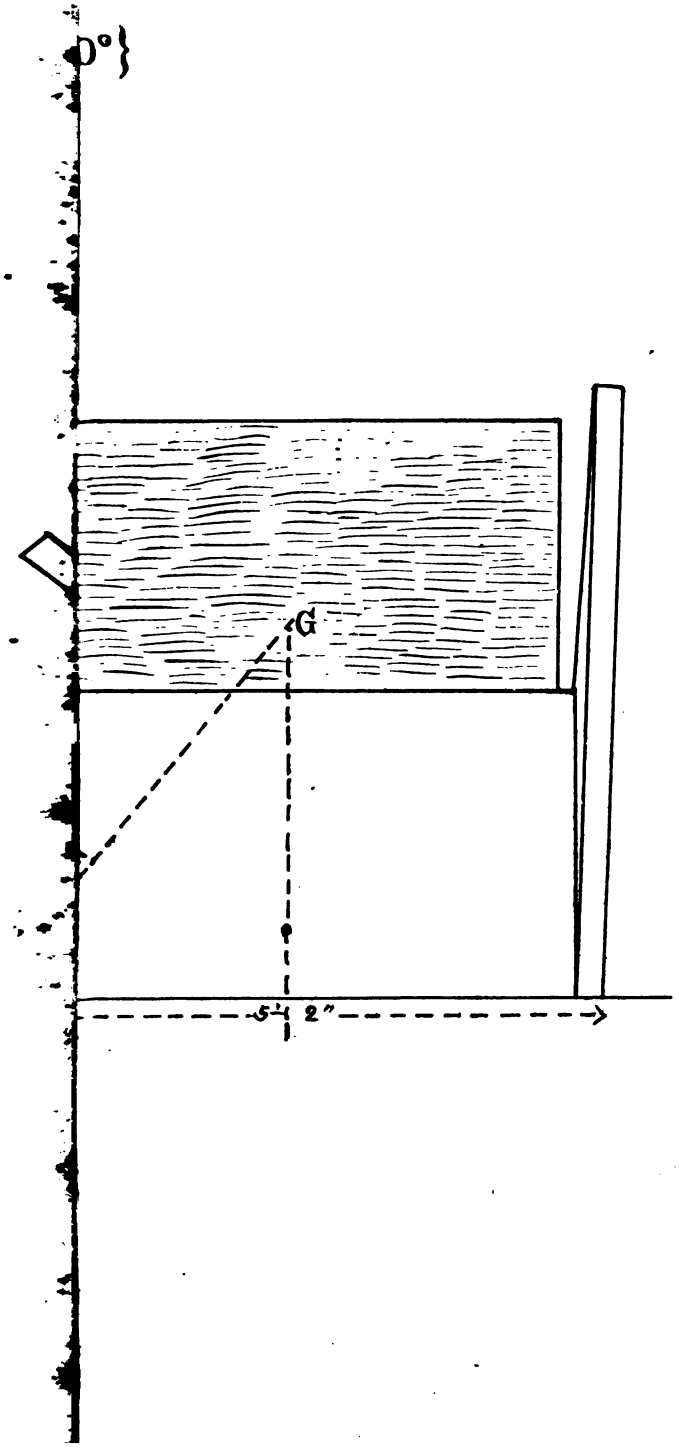


Plate 11.

ACTION OF DISCHARGE ON FIELD GUN CARRIAGE (1.535 R. M. L.)

Scale 1 in. – 1 ft.

Plate III.

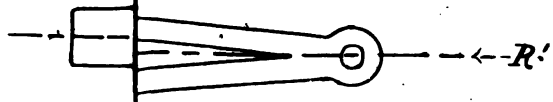
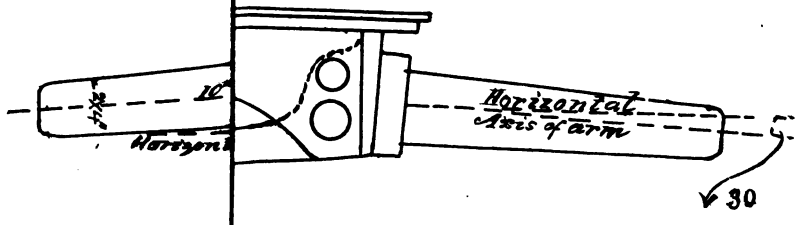


Plate IV.



CYLINDER
of the
Moncrief Hydro-pneumatic Carriage.

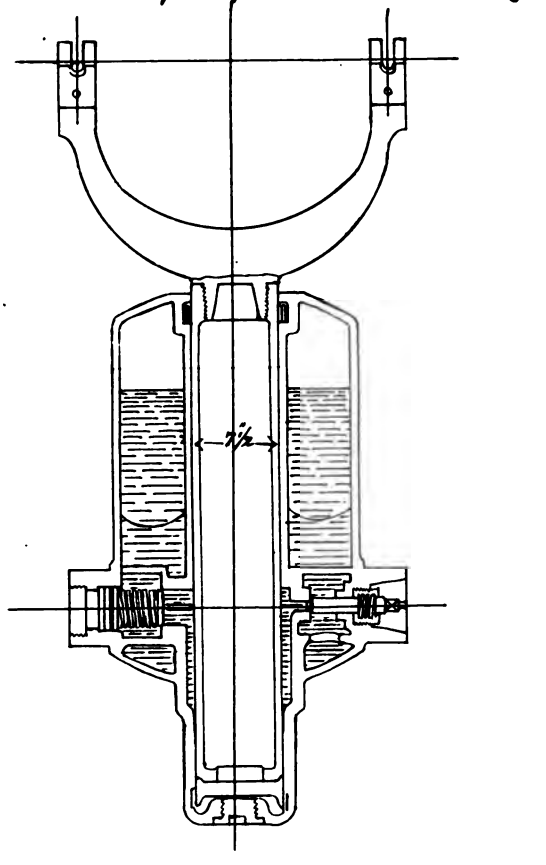
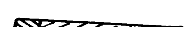


Plate VII.



The [illegible] Compressor

The "Bow" Compressor.

Plate VII.